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Koseki

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(54) **IMAGE FORMING APPARATUS AND COLLECTING CONTAINER**

(71) Applicant: **CANON KABUSHIKI KAISHA**, Tokyo (JP)

(72) Inventor: **Hiromichi Koseki**, Tokyo (JP)

(73) Assignee: **Canon Kabushiki Kaisha**, Tokyo (JP)

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G03G 15/00 (2006.01)
G03G 21/12 (2006.01)
G03G 21/16 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 21/12*** (2013.01); ***G03G 21/1647*** (2013.01)

(58) **Field of Classification Search**
CPC G03G 21/10; G03G 21/1647; G03G 21/12
USPC 399/360
See application file for complete search history.

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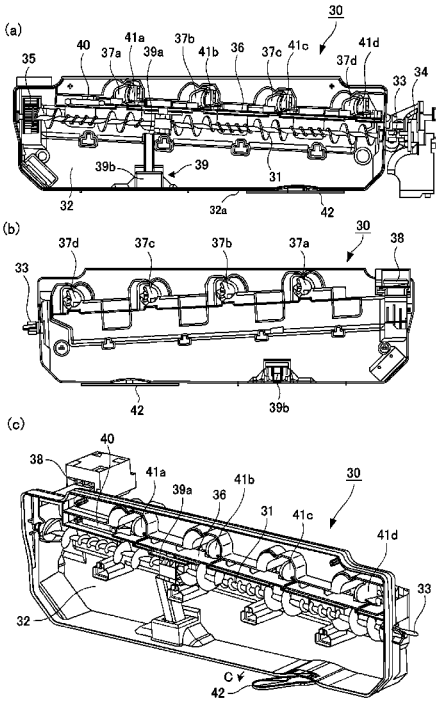
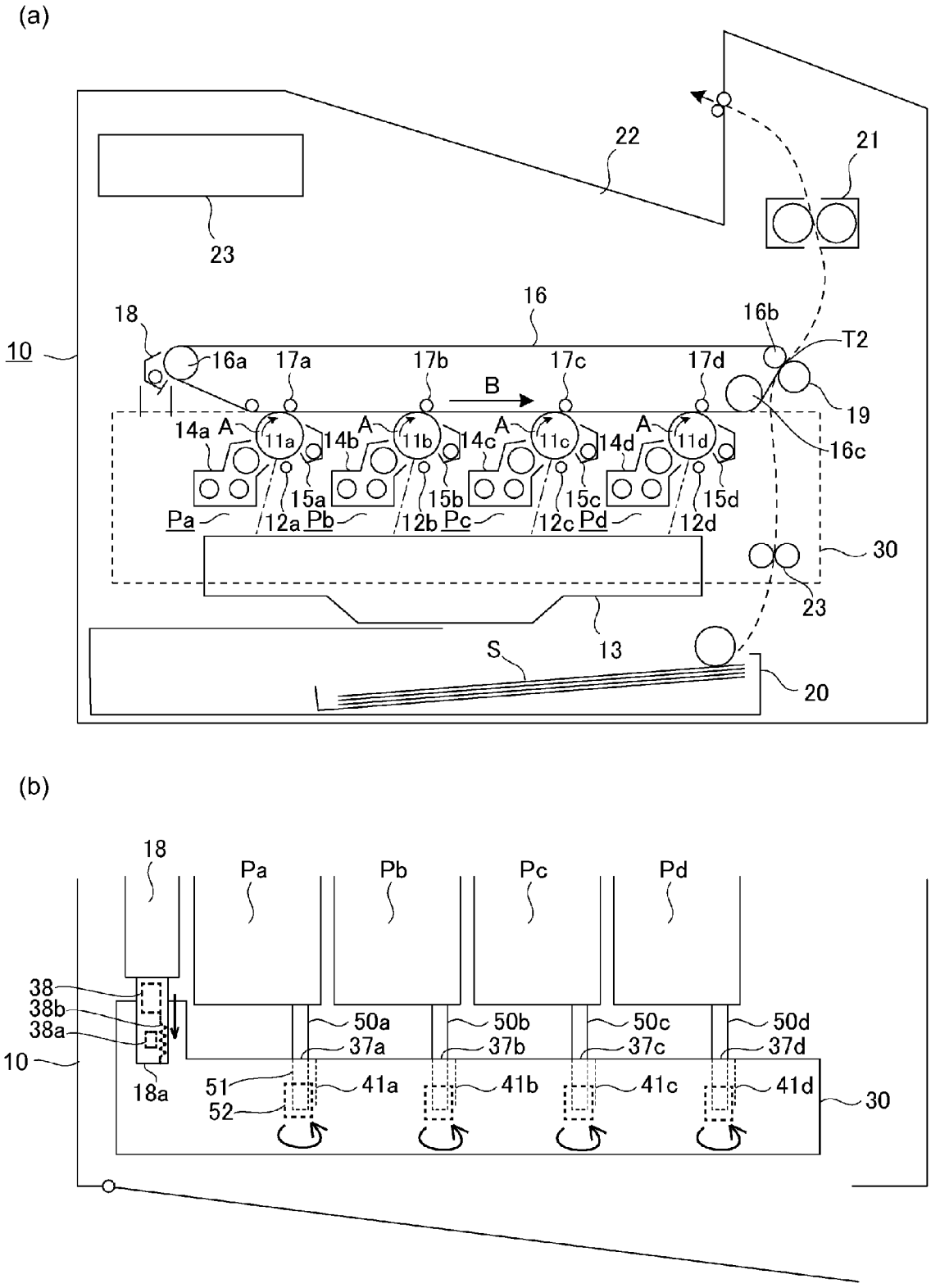
Primary Examiner — David Bolduc
Assistant Examiner — Barnabas Fekete
(74) *Attorney, Agent, or Firm* — Fitzpatrick, Cella, Harper & Scinto

(57) **ABSTRACT**

An image forming apparatus includes a collecting container; connecting portions; shutters; first urging members for urging the shutters; a movable member which is accommodated toward the collecting container by contact with the main assembly when the collecting container is mounted in a mounting portion and which is projected outwardly from a side portion of the collecting container when the collecting container is dismounted from the mounting position; and a second urging member for urging the movable member. When the collecting container is mounted in the main assembly, the first urging members and the second urging member are provided so that a sum of rotation moment acting on the collecting container by the first urging members and rotation moment acting on the collecting container by the second urging member are directed opposite to each other.

6 Claims, 10 Drawing Sheets




(a)
22
21
23
16
18
16b
T2
10
16a
17a
17b
17c
17d
B
19
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A
11a
14b
11b
14c
11c
14d
11d
16c
15a
15b
15c
15d
Pa
12a
Pb
12b
Pc
12c
Pd
12d
30
23
S
13
20
(b)
18
Pa
Pb
Pc
Pd
38
38b
38a
10
50a
50b
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51
52
41a
41b
41c
41d
30

Fig. 1

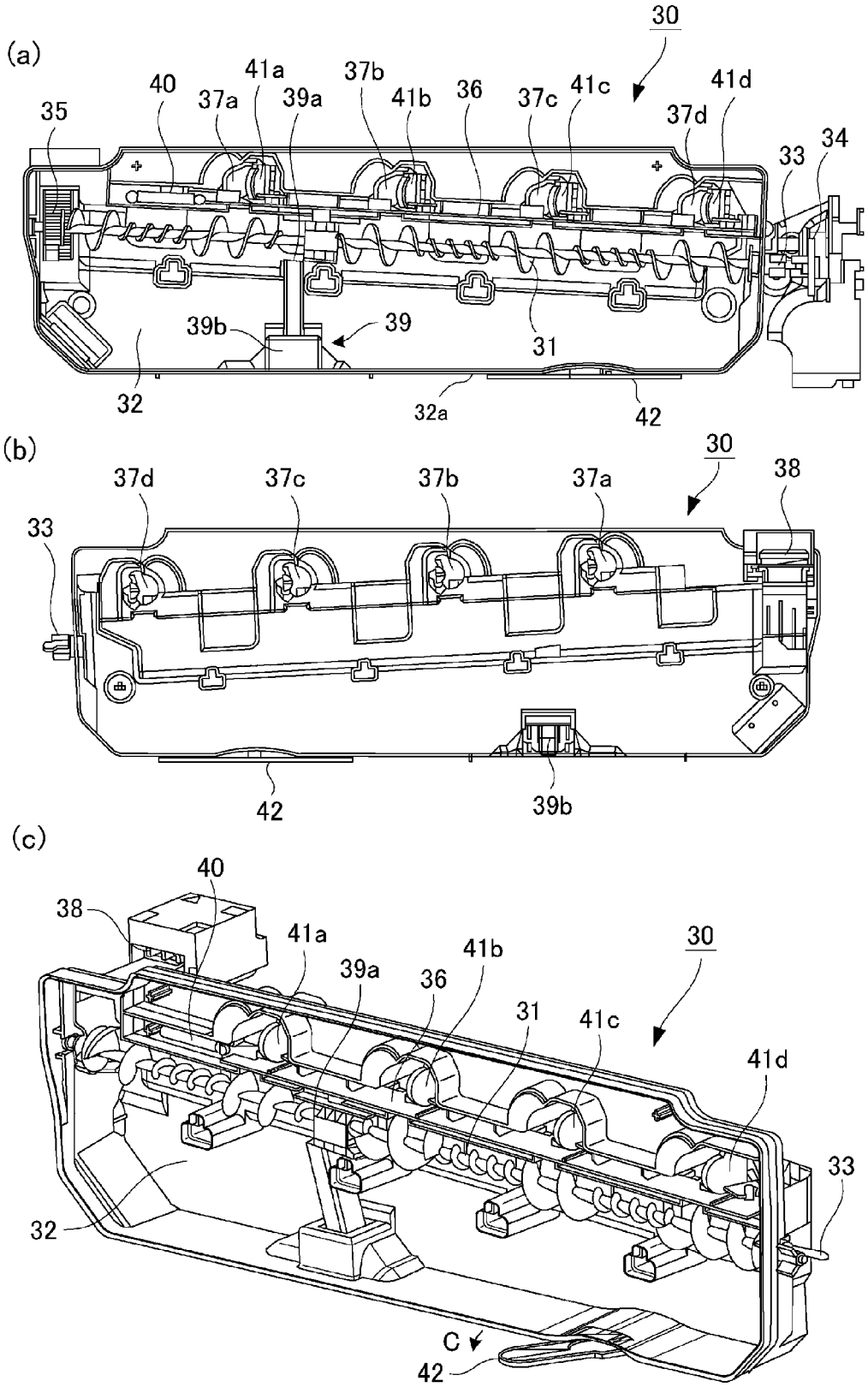

(a)
30
35
40
37a
41a
39a
37b
41b
36
37c
41c
37d
41d
33
34
39b
39
31
32
32a
42
(b)
30
37d
37c
37b
37a
38
33
42
39b
(c)
40
38
41a
39a
41b
36
31
41c
30
41d
33
32
C
42

Fig. 2

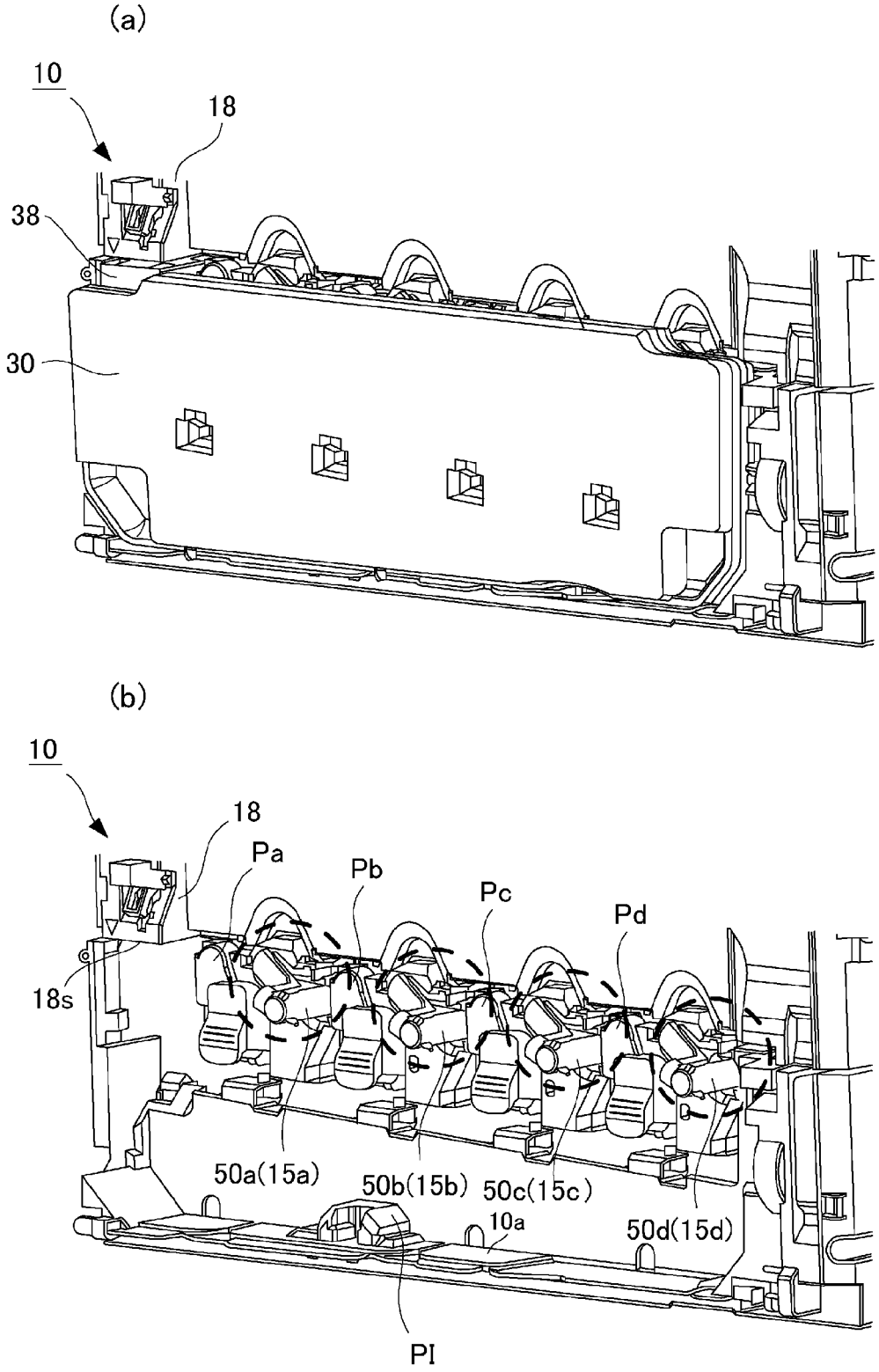
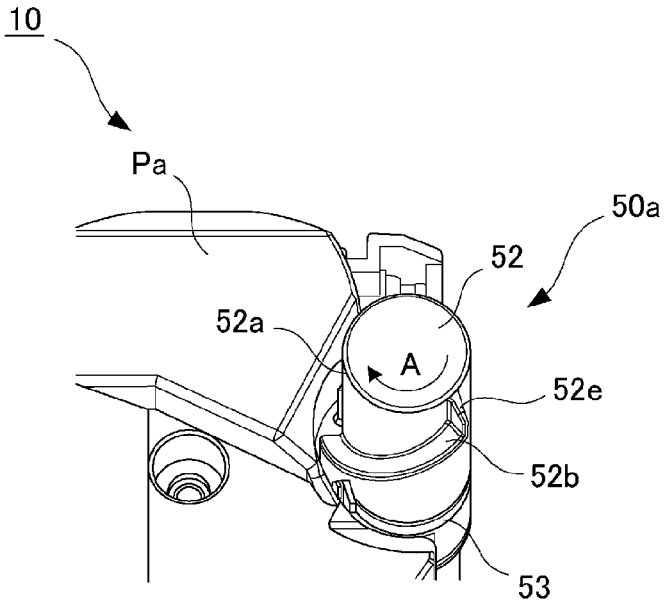

(a)
10
18
38
30
(b)
10
18
Pa
Pb
Pc
Pd
18s
50a(15a)
50b(15b)
50c(15c)
10a
50d(15d)
PI

Fig. 3



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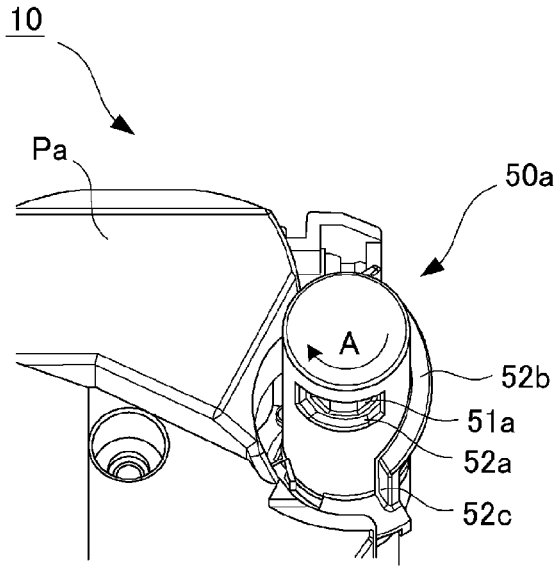

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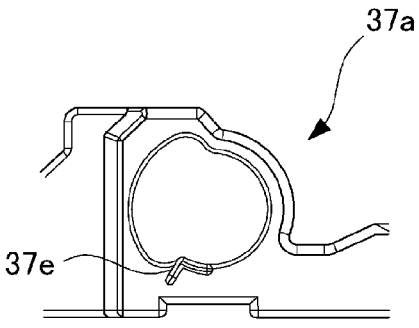


(c)

Fig. 4

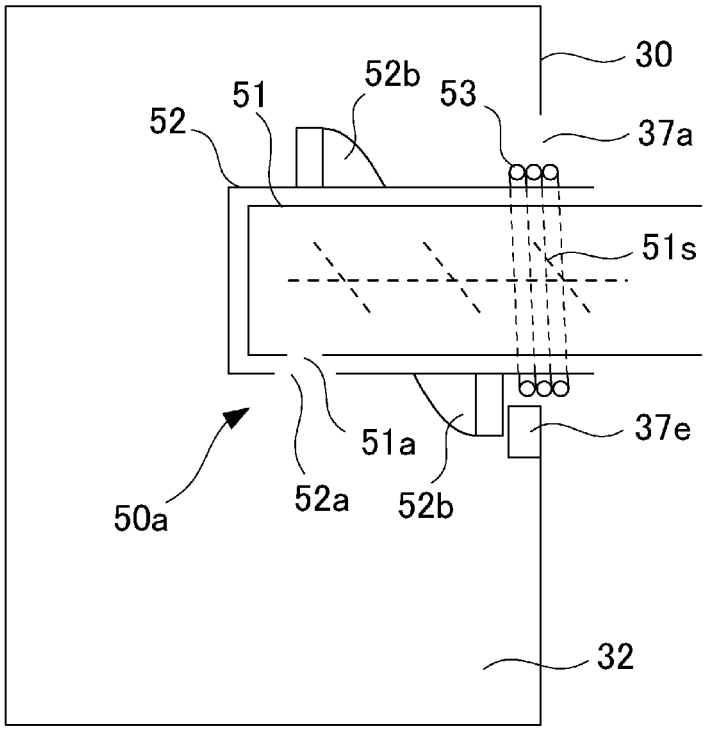
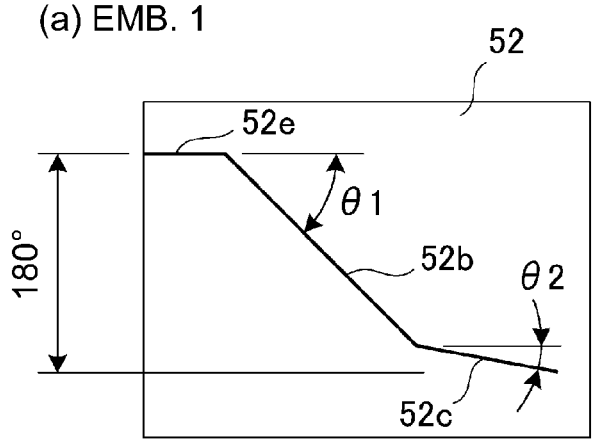
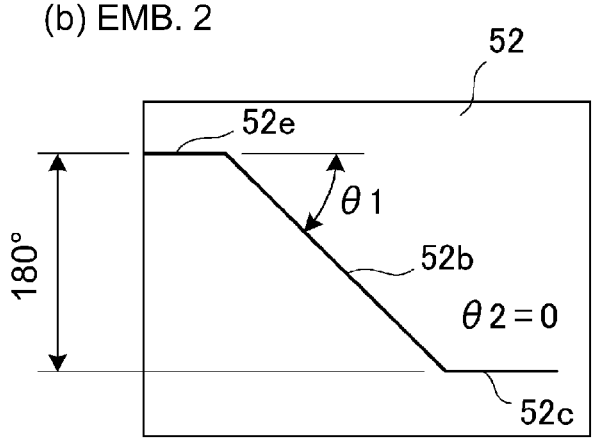


Fig. 5

(a) EMB. 1



(b) EMB. 2



(c) EMB. 3

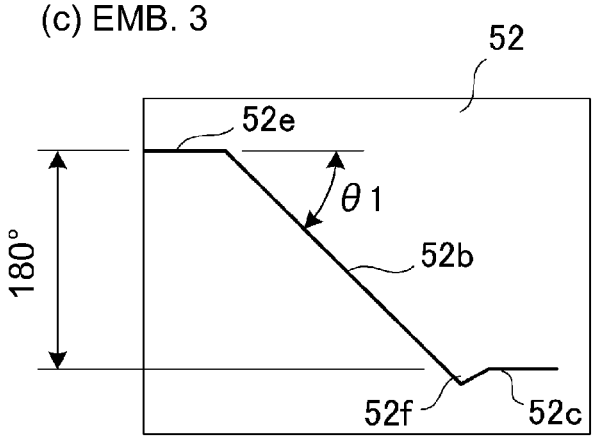


Fig. 6

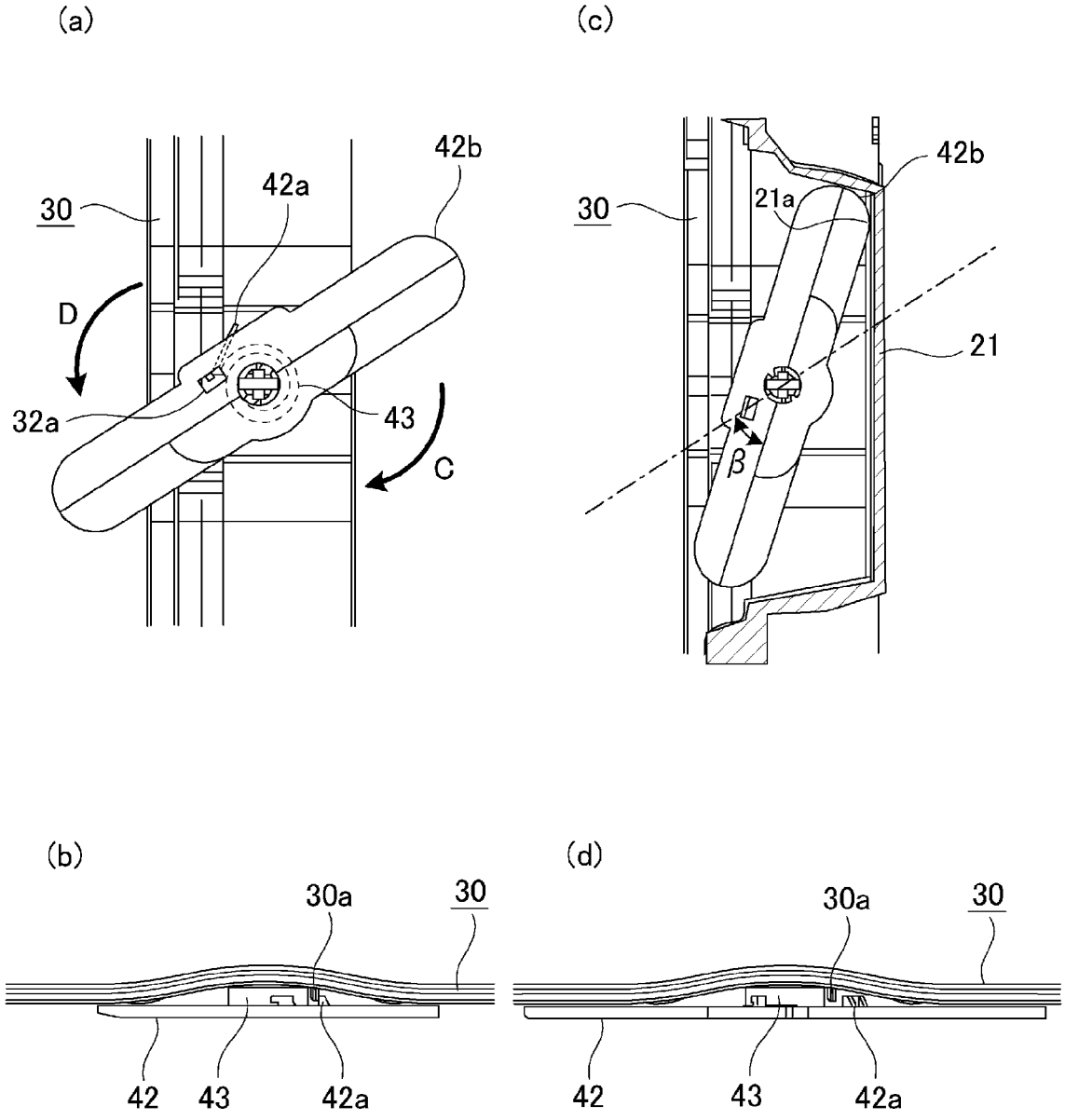
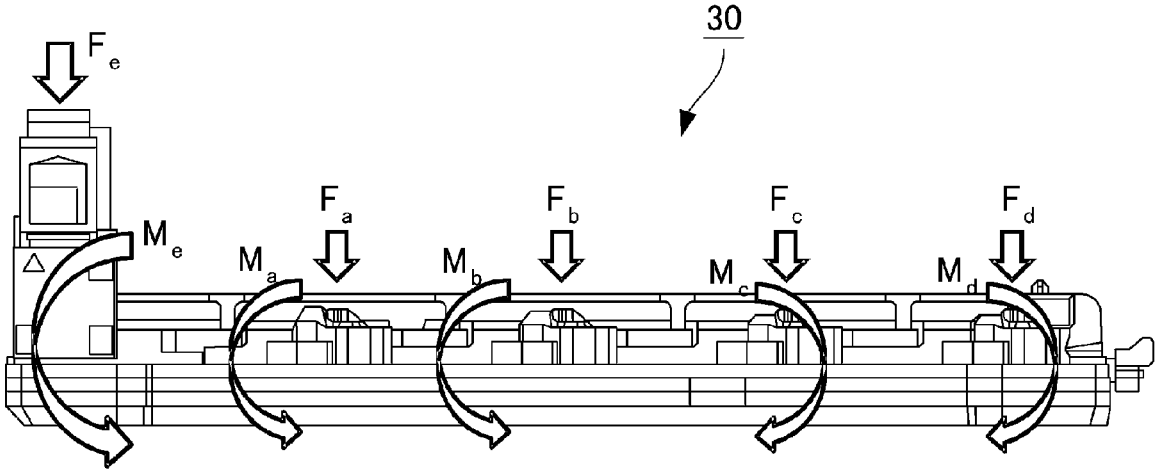


Fig. 7

(a) COMP. EX



(b) EMB. 1

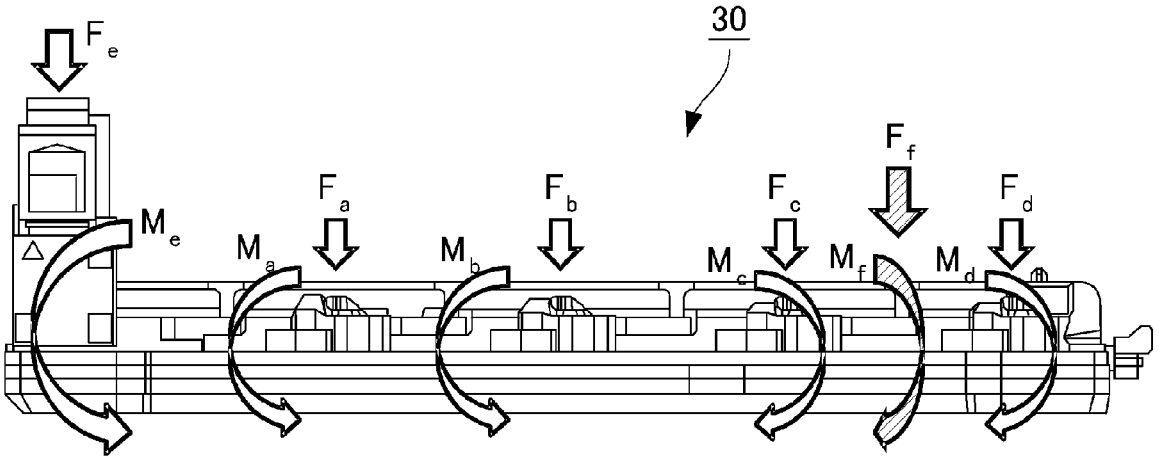
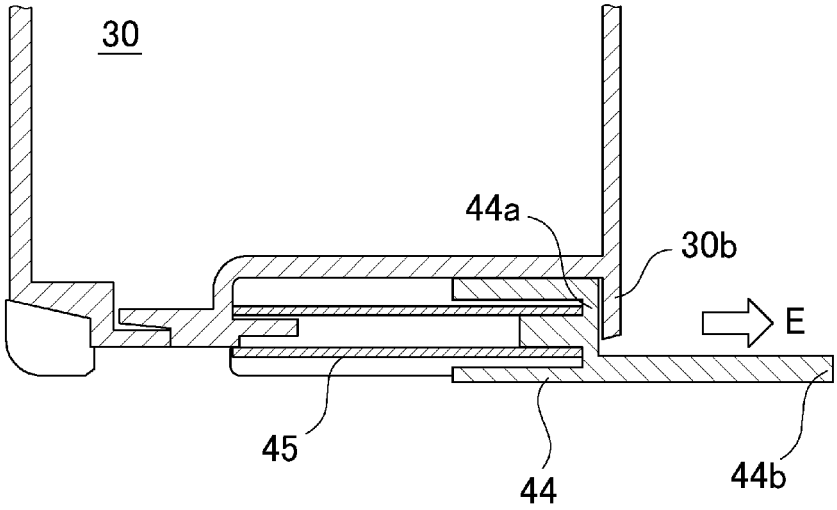


Fig. 8

(a)



(b)

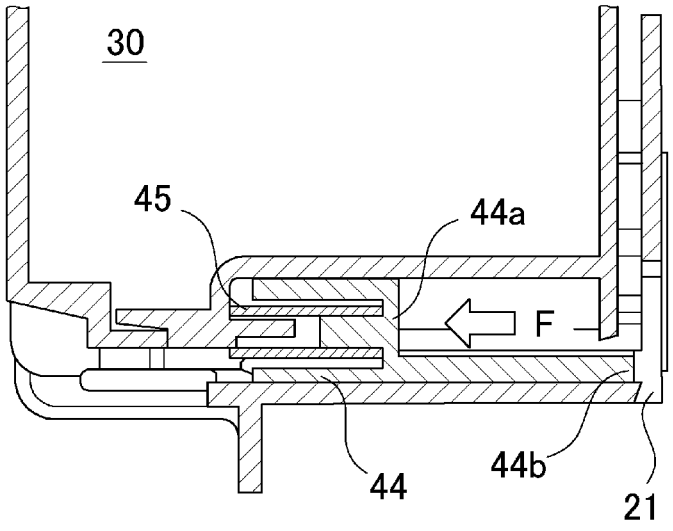
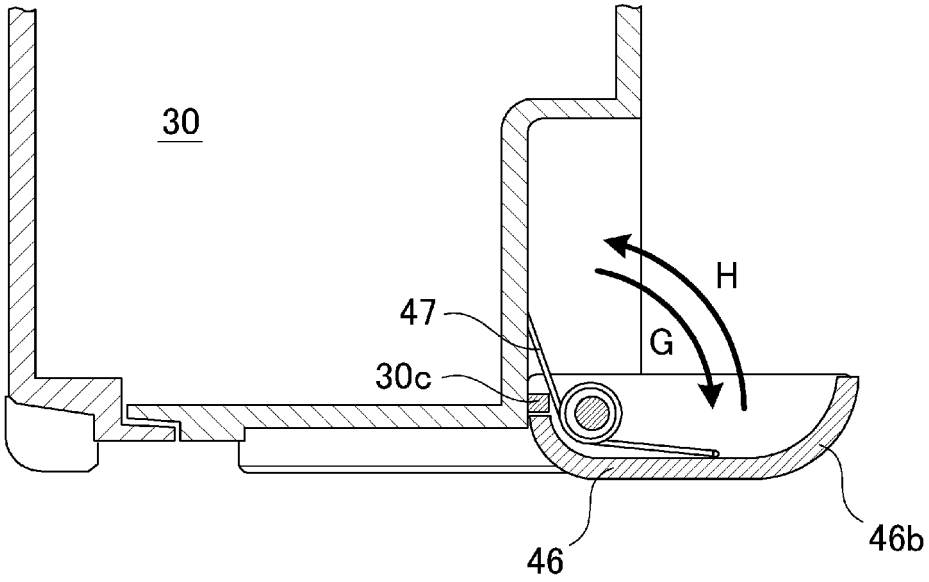


Fig. 9

(a)



(b)

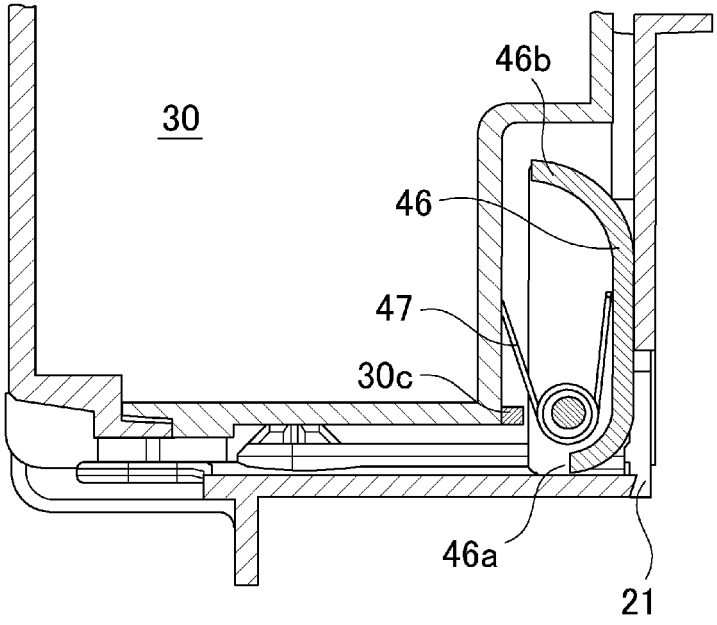


Fig. 10

IMAGE FORMING APPARATUS AND COLLECTING CONTAINER

FIELD OF THE INVENTION AND RELATED ART

The present invention relates to an image forming apparatus for collecting a toner fed from a main assembly into a collecting container detachably mountable to the main assembly of the image forming apparatus, and specifically relates to the collecting container connected to the main assembly at connecting portions provided with shutters.

In the image forming apparatus in which a toner image is formed using the toner and then is transferred onto a sheet, a transfer residual toner is generated with the transfer of the toner image, and therefore a cleaning device is provided to collect the transfer residual toner. There is also the case where a developer which becomes old is collected from a developing device with an operation of the developing device. The toner collected by the cleaning device or the developing device is accumulated in the collecting container provided detachably mountable to the main assembly, and when the collecting container becomes full, there is the case where the collecting container in its entirety is dismounted from the main assembly and then is replaced with a blank collecting container (Japanese Laid-Open Patent Application (JP-A) 2008-107436, JP-A 2010-38993 and JP-A 2010-160512).

In the image forming apparatus to which the collecting container is detachably mountable, when the collecting container is separated from the main assembly and then is overturned, there is a possibility that a collected toner is scattered to a periphery. In order to prevent the overturning of the collecting container, in JP-A 2008-107436 and JP-A 2010-38993, the collecting container is provided with an overturning-preventing member, stored in an accommodating portion provided on a container portion for accumulating the toner, for supporting the container portion in a state in which the overturning-preventing member is rotated and developed toward an outside.

On the other hand, at the connecting portion for connecting the main assembly of the image forming apparatus and the collecting container, the shutter for preventing leakage-out of the toner is provided. In JP-A 2010-160512, both the main assembly and the collecting container are provided with the shutter. The shutter is urged in a closing direction by an urging member, and automatically seals openings, provided in the main assembly side and the collecting container side, with an operation for separating the collecting container from the main assembly.

The shutter provided at the connecting portion between the main assembly of the image forming apparatus and the collecting container urges the collecting container in a direction of separating the collecting container from the main assembly. For that reason, in the case where the collecting container is connected to the image forming apparatus at a plurality of connecting portions, a sum of rotation moment with which a plurality of shutters act on the collecting container is not canceled at both ends with respect to a horizontal direction and thus unnecessary rotation moment acts on the collecting container in some instances.

SUMMARY OF THE INVENTION

A principal object of the present invention is to provide an image forming apparatus and a collecting container which are capable of alleviating unnecessary rotation moment acting on the collecting container.

According to an aspect of the present invention, there is provided an image forming apparatus comprising: a collecting container, provided detachably mountable to a main assembly, for collecting a toner fed from the main assembly; a plurality of connecting portions, provided at one side surface of the collecting container, for connecting the main assembly and the collecting container; a plurality of shutters for opening and closing the plurality of connecting portions, respectively; a plurality of first urging members for urging the plurality of shutters, respectively, in a closing direction; a movable member provided movably at a bottom of the collecting container, wherein the movable member is accommodated toward the collecting container by contact with the main assembly when the collecting container is mounted in a mounting portion, and is projected outwardly than a side portion of the collecting container when the collecting container is dismounted from the mounting position; and a second urging member for urging the movable member in a direction of projecting the movable member from the collecting container, wherein when the collecting container is mounted in the main assembly, the plurality of first urging members and the second urging member are provided so that a sum of rotation moment acting on the collecting container by the plurality of first urging members, and rotation moment acting on the collecting container by the second urging member are directed opposite to each other.

According to another aspect of the present invention, there is provided a collecting container provided detachably mountable to a main assembly of an image forming apparatus, comprising: an accommodating portion for accommodating a toner; a plurality of inflowing portions, provided at one side surface of the collecting container, for permitting inflow of the toner; a plurality of shutters for opening and closing the plurality of inflowing portions, respectively; a plurality of first urging members for urging the plurality of shutters, respectively, in a closing direction; a movable member provided movably at a bottom of the accommodating portion, wherein the movable member is accommodated toward the collecting container by contact with the main assembly when the collecting container is mounted in the main assembly, and is projected outwardly than a side portion of the collecting container when the collecting container is dismounted from the mounting position; and a second urging member for urging the movable member in a direction of projecting the movable member from the collecting container, wherein when the collecting container is mounted in the main assembly, the plurality of first urging members and the second urging member are provided so that a sum of rotation moment acting on the collecting container by the plurality of first urging members, and rotation moment acting on the collecting container by the second urging member are directed opposite to each other.

These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In FIG. **1**, (a) and (b) are illustrations of a structure of an image forming apparatus.

In FIG. **2**, (a), (b) and (c) are illustrations of a structure of a collected toner box.

In FIG. **3**, (a) and (b) are illustrations of a mounted state and a dismounted state, respectively, of the collected toner box.

In FIG. **4**, (a), (b) and (c) are illustrations of a shutter mechanism.

FIG. **5** is a schematic view of an operation of the shutter mechanism.

In FIG. **6**, (a), (b) and (c) each shows an operation of a blind shutter.

In FIG. **7**, (a) to (d) are illustrations of an overturning-preventing member in Embodiment 1.

In FIG. **8**, (a) and (b) are illustrations of a rotation moment suppressing effect by the overturning-preventing member.

In FIG. **9**, (a) and (b) are illustrations of an overturning-preventing member in Embodiment 2.

In FIG. **10**, (a) and (b) are illustrations of an overturning-preventing member in Embodiment 3.

DESCRIPTION OF THE EMBODIMENTS

Embodiments of the present invention will be described specifically with reference to the drawings.

(Image forming apparatus)

In FIG. **1**, (a) and (b) are illustrations of a structure of an image forming apparatus. In FIG. **1**, (a) shows a longitudinal section of the image forming apparatus, and (b) shows a connected state of a collected toner box.

As shown in (a) of FIG. **1**, an image forming apparatus **10** is an intermediary transfer type full-color printer of a tandem type in which image forming portions Pa, Pb, Pc and Pd for yellow, magenta, cyan and black, respectively, are arranged along a downward surface of an intermediary transfer belt **16**. An operation of the image forming apparatus **10** is controlled by a controller **23**.

At the image forming portion Pa, a yellow toner image is formed on a photosensitive drum **11***a* and then is transferred onto the intermediary transfer belt **16**. At the image forming portion Pb, a magenta toner image is formed on a photosensitive drum **11***b* and then is transferred onto the intermediary transfer belt **16**. At the image forming portions c and d, cyan and black toner images are formed on photosensitive drums **11***c* and **11***d*, respectively, and then are transferred onto the intermediary transfer belt **16**.

A sheet (recording material) S is taken out from a cassette **20** one by one, and then is on stand-by at a registration roller pair **23**. The registration roller pair **23** feeds the sheet S to a secondary transfer portion T**2** while being timed to the toner images on the intermediary transfer belt **16**. The sheet S on which the four color toner images are secondary transferred at the secondary transfer portion T**2** is fed to a fixing device **21** and an image thereon is fixed under application of heat and pressure, and thereafter the sheet S is discharged onto a discharge tray **22**.

(Image forming portion)

As shown in (a) of FIG. **1**, the image forming portions Pa, Pa, Pc and Pd have the substantially same constitution except that colors of toners used in developing devices **14***a*, **14***b*, **14***c* and **14***d*, respectively, are yellow, magenta, cyan and black, respectively, which are different from each other. In the following, the yellow image forming portion Pa is described, and redundant explanation about other image forming portions Pb, Pc and Pd will be omitted.

The image forming portion Pa includes, at a periphery of the photosensitive drum **11***a*, a charging roller **12***a*, an exposure device **13**, the developing device **14***a*, a transfer roller **17***a* and a drum cleaning device **15***a*. The photosensitive drum **11***a* is prepared by forming a photosensitive layer at an outer peripheral surface thereof, and is rotated in an arrow A direction. The charging roller **12***a* electrically charges a surface of the photosensitive drum **11***a* to a negative dark portion potential VD uniformly. The exposure device **13** scans the surface of the photosensitive drum **11***a* with a laser beam, so that an electrostatic image for an image is formed on the photosensitive drum **11***a*. The developing device **14***a* develops the electrostatic image on the photosensitive drum **11***a* into a toner image by carrying, on a developing sleeve, a developer containing a toner and a carrier.

The transfer roller **17***a* forms a transfer portion for the toner image between the photosensitive drum **11***a* and the intermediary transfer belt **16**. By applying a DC voltage to the transfer roller **17***a*, the toner image carried on the photosensitive drum **11***a* is transferred onto the intermediary transfer belt **16**.

The intermediary transfer belt **16** is extended around and supported by a tension roller **16***a*, a driving roller **16***c* and an inner secondary transfer roller **16***b*, and is driven by the driving roller **8***b* to be rotated in an arrow B direction. A secondary transfer roller **19** contacts the intermediary transfer belt **16** supported by the inner secondary transfer roller **16***b* to form the secondary transfer portion T**2** for the toner image.

(Collected Toner)

As shown in (a) of FIG. **1**, with the image formation, the transfer residual toner is deposited on the photosensitive drum **11***a*. The transfer residual toner is scraped off by a cleaning blade of the drum cleaning device **15***a*, and then is fed toward the front side of the image forming apparatus **10** by a feeding screw to be accumulated in a collecting container **30**. The transfer residual toner deposited on the intermediary transfer belt **16** is scraped off by a cleaning blade of a belt cleaning device **18**, and then is fed toward the front surface side of the image forming apparatus **10** by the feeding screw to be accumulated in the collecting container **30**.

When a two-component developer is continuously stirred over a long time, a charging performance is gradually lowered, and therefore the two-component developer in a certain proportion is steadily taken out from the developing device **14***a* and is collected in the collecting container **30**. Into the developing device **14***a*, in order to replenish the toner consumed with the image formation, a supply developer containing the carrier in an amount of about 10% is supplied. The developer circulating in the developing device **14***a* overflows the developing device **14***a* little by little in a proportion depending on a toner consumption amount with the image formation, and then is accumulated as a deteriorated developer in the collecting container **30**.

As shown in (b) of FIG. **1**, a connecting portion of the belt cleaning device **18** and delivery portions **50***a*, **50***b*, **50***c* and **50***d* of the drum cleaning devices **15***a*, **15***b*, **15***c* and **15***d* are individually provided with shutters, and are connected to the collected toner box **30**.

(Collected Toner Box)

In FIG. **2**, (a), (b) and (c) are illustrations of a structure of the collected toner box. In FIG. **3**, (a) and (b) are illustrations of a mounted state and a dismounted state, respectively, of the collected toner box. In FIG. **2**, (a) is a sectional front view of the collected toner box, (b) is a rear view of the collected toner box, and (c) is perspective view of the collected toner box. In FIG. **3**, (a) shows the mounted state in which the collected toner box is mounted in the image forming apparatus, and (b) shows the dismounted state in which the collected toner box is dismounted from the image forming apparatus.

As shown in (a) of FIG. **2**, a stirring screw **31** stirs the toner accumulated at an accommodating portion **32** of the collected toner box **30**. A screw flag **33** is constrained by an interval of bosses formed on a coupling **34**, so that a driving force from a motor in the image forming apparatus side is transmitted to the stirring screw **31**. The collected toner discharged into the collected toner box **30** is flattened in the accommodating

portion **32** by the stirring screw **31** when the collected toner is accumulated to a height of the stirring screw **31**.

A stirring paddle **35** is driven by an unshown crank shaft interrelated with the stirring screw **31**, and is reciprocated in a direction perpendicular to the surface of the drawing sheet. The stirring paddle **35** scrapes off the toner, into the accommodating portion **32**, discharged from the intermediary transfer belt cleaning device **18** shown in (a) of FIG. **1** into the collected toner box **30** and then deposited in a space inside a shutter **38** shown in (b) of FIG. **2**.

(Full-State Detection)

As shown in (a) of FIG. **2**, in the accommodating portion **32**, when the collected toner flattened by the stirring screw **31** reaches an entrance **39***a* to a toner amount detecting portion **39***b*, the collected toner enters the inside of the toner amount detecting portion **39**. The toner amount detecting portion **39***b* causes a photo-interruptor PI, provided in the image forming apparatus **10** side as shown in (b) of FIG. **3**, to continuously monitor presence or absence of the toner. When the collected toner is accumulated at the collected toner detecting portion **39***b* and a detection optical path of the photo-interruptor PI is blocked, the controller **23** (FIG. **1**) discriminates that the collected toner box is full, and displays a message of "Exchange requirement of collected toner box **30**" on an operating panel.

(Mounting and Dismounting of Collected Toner Box)

As shown in (b) of FIG. **3**, when the collected toner box **30** (FIG. **2**) is dismounted from a predetermined position at a lower position of the image forming apparatus, the belt cleaning device **18** and the image forming portions Pa, Pb, Pc and Pd are exposed. From the image forming portions Pa, Pb, Pc and Pd, the delivery portions **50***a*, **50***b*, **50***c* and **50***d* project. Each of the belt cleaning device connecting portion **18***s* and the delivery portions **50***a*, **50***b*, **50***c* and **50***d* of the drum cleaning devices **15***a*, **15***b*, **15***c* and **15***d* is sealed with a shutter.

As shown in (a) of FIG. **2**, between an upper space connected to the delivery portions **50***a*, **50***b*, **50***c* and **50***d* and the accommodating portion **32** disposed at the lower portion where the toner is to be accumulated, a sealing member **36** is urged in an urging direction by a tension spring **40**. Receiving ports **37***a*, **37***b*, **37***c* and **37***d* are provided with receiving port shutters **41***a*, **41***b*, **41***c* and **41***d*, respectively, each opening and closing in interrelation with the sealing member **36**.

The collected toner box **30** taken out from the image forming apparatus **10** is in a second state (self-supporting state). In the second state, the sealing member **36** and the receiving port shutters **41***a*, **41***b*, **41***c* and **41***d* maintain a sealing state, and even when the collected toner box overturns, do not spill the toner toward the outside. In the second state, the sealing member **36** sealing between a receiving port **37** and the accommodating portion **32** seals between an entrance **39***a* of a toner detecting portion and the accommodating portion **32**, and therefore even when the collected toner box **30** overturns, the toner does not enter the entrance **39***a*.

As shown in (a) of FIG. **3**, the collected toner box **30** is mounted to a predetermined lower position of the image forming apparatus **10** by inserting the delivery portions **50***a*, **50***b*, **50***c* and **50***d* into the receiving ports **37***a*, **37***b*, **37***c* and **37***d*. When the collected toner box **30** is mounted in the image forming apparatus **10**, to a side surface portion of the collected toner box **30** with respect to a longitudinal direction, a belt cleaning device connecting portion **18***s* and the delivery portions **50***a*, **50***b*, **50***c* and **50***d* are connected. As a result, the collected toner box **30** is in a first state (mounted state) in which the collected toner box **30** is capable of receiving the collected toner. The transfer residual toner collected by the drum cleaning devices **15***a*, **15***b*, **15***c* and **15***d* is discharged into the collected toner box **30** through a delivery port **51***a* (FIG. **4**) provided in a lower side of the delivery portions **50***a*, **50***b*, **50***c* and **50***d*.

As shown in (a) of FIG. **2**, in the first state, the receiving port shutters **41***a*, **41***b*, **41***c* and **41***d* are urged by the delivery portions **50***a*, **50***b*, **50***c* and **50***d* to be opened toward an inside. In interrelation with the receiving port shutter **41**, the sealing member **36** slides against the tension spring **40** to cause the receiving ports **37***a*, **37***b*, **37***c* and **37***d* to communicate with the accommodating portion **32**.

(Connection of Intermediary Transfer Belt Cleaning Device)

As shown in (b) of FIG. **1**, a collected toner discharging portion **18***a* of the intermediary transfer belt cleaning device **18** is provided with a shutter **38** which opens and closes by sliding in an insertion and extraction direction of the collected toner box **30**. The shutter **38** is urged in a sealing direction by a shutter spring **38***b*, and in the second state in which the shutter **38** is dismounted from the image forming apparatus **10**, the shutter **38** always maintains a sealed state of the opening **38***a*, and even when the collected toner box **30** overturns, the shutter **38** does not spill the toner to the outside. The shutter **38** slides in an open direction with the connection of the collected toner box **30** to cause the belt cleaning device **18** and the inner space of the collected toner box **30** to communicate with each other.

In the case of the shutter **38** sliding in the insertion and extraction direction of the collected toner box **30**, it is possible to ensure a space, for retracting the shutter in an open state, in a rear side where the collected toner box **30** to be inserted. However, in the rear side of the delivery portions **50***a*, **50***b*, **50***c* and **50***d* where the collected toner box **30** is to be inserted, there is no space for retracting the shutter sliding in the insertion and retraction direction of the collected toner box **30**.

Therefore, the delivery portions **50***a*, **50***b*, **50***c* and **50***d* are provided with shutters **52** for sealing openings of the delivery portions **50***a*, **50***b*, **50***c* and **50***d* by rotation of the shutters **52** coaxially with the delivery portions **50***a*, **50***b*, **50***c* and **50***d*.

(Structure of Delivery Portion)

In FIG. **4**, (a) to (c) are illustrations of a shutter mechanism. FIG. **5** is a schematic view of an operation of the shutter mechanism. In FIG. **6**, (a) to (c) are illustrations of an operation of a blind shutter. In FIG. **4**, (a) shows a sealed state, (b) shows an open state, and (c) shows a shutter driving portion disposed in the collected toner box side.

As shown in (b) of FIG. **3**, the delivery portion **50***a* projecting from the image forming portion Pa is inserted into the collected toner box **30** to discharge the collected toner.

As shown in (a) of FIG. **4**, the sealing shutter **52** is formed in a closed-end cylindrical shape, and is 180°-rotatable coaxially with a feeding pipe **51** along an outer peripheral surface of a free end portion of the feeding pipe **51**. The sealing shutter **52** rotates along the peripheral surface of the feeding pipe **51**, and therefore the retraction space is limited to a rotation region of the sealing shutter **52** even in the sealing state, the open state and an operation process. Accordingly, compared with a shutter **38** (FIG. **2**) sliding in the insertion direction, it is possible to seal the delivery portion **51***a* in a small space.

As shown in (a) of FIG. **4**, in an initial stage in which the collected toner box **30** is pushed in and mounted in the image forming apparatus **10**, the sealing shutter **52** of the delivery portion **50***a* is in the sealing state and prevents drop of the toner from the delivery portion **50***a*.

As shown in (b) of FIG. **4**, in the first state in which the collected toner box **30** is mounted in the image forming

apparatus **10**, the sealing shutter **52** of the delivery portion **50***a* is held in the open state, so that the toner can drop from the delivery portion **50***a* into the collected toner box **30**.

As shown in (c) of FIG. **4**, the receiving port **37***a* of the collected toner box **30** is provided with a contact rib **37***e* for rotating the sealing shutter **52** in contact with a helical rib **52***b* of the sealing shutter **52**.

As shown in FIG. **5**, the delivery portion **50***a* is connected to the receiving port **37***a* of the collected toner box **30**. The collected toner is fed by the feeding screw **51***s* toward the delivery port **51***a* in the feeding pipe **51**. The sealing shutter **52** is urged by a helical torsion coil spring **53**, and therefore in a state in which the collected toner box **30** is not connected, the sealing shutter **52** always keeps the delivery port **51***a* in a sealed state. In a process in which the delivery portion **50***a* is inserted into the collected toner box **30**, the contact rib **37***e* provided on the receiving port **37***a* contacts the helical rib **52***b* of the sealing shutter **52** and rotates the sealing shutter **52** along the peripheral surface of the feeding pipe **51**.

In the first state in which the collected toner box **30** is mounted in the image forming apparatus **10**, the rotation of the sealing shutter **52** is stopped in an overlapping state of the delivery port **51***a* with the sealing shutter opening **52***a*. The collected toner in the feeding pipe **51** is discharged into the collected toner box **30** through a hole where the delivery port **51***a* and the sealing shutter opening **52***a* overlap with each other.

(Blind Shutter)

As shown in (b) of FIG. **4**, in the first state, when the collected toner is discharged from the delivery port **50***a* into the collected toner box **30**, a spent toner passing through the receiving port **51***a* deposits on the sealing shutter opening **52***a*.

As shown in (a) of FIG. **4**, in the second state, when the sealing shutter opening **52***a* seals the receiving port **51***a*, a blind shutter **54** covers the sealing shutter opening **52***a*, thus preventing scattering of the toner depositing on the sealing shutter opening **52***a*.

As shown in (b) of FIG. **4**, the blind shutter **54** is movable relative to the image forming portion Pa in an arrow B direction perpendicular to an axis of the delivery pipe **51**.

(Reaction Force During Mounting and Dismounting)

As shown in (b) of FIG. **4**, during the pushing-in of the collected toner box **30**, the helical rib **52***b* contacts the contact rib **37***e* of the collected toner box **30** and rotates the sealing shutter **52**. In the first state in which the collected toner box **30** is completely mounted in the image forming apparatus **10**, a flat plate rib **52***c* contacts the contact rib **37***e* of the collected toner box **30**. In the first surface, the contact rib **37***e* passes through the helical rib **52***b* and then reaches the flat plate rib **52***c*, and therefore a force for pushing the collected toner box **30** back in a direction opposite to the insertion direction by the sealing shutter **52** becomes small.

Here, an inclination angle of the helical rib **52***b* with respect to a generatrix direction of the feeding pipe **51** is θ**1**. An inclination angle of the flat plate rib **52***c*, connected to the helical rib **52***b* in a base position side, with respect to the generatrix direction of the feeding pipe **51** is θ**2**. In order to make an urging force in a rotational direction by the helical torsion coil spring **53** lower than that during the pushing-in in the first state, the inclination angle θ**1** of the helical rib **52***b* and the inclination angle θ**2** of the flat plate rib **52***c* are set as follows:

$$\theta 1 > \theta 2.$$

As shown in FIG. **5**, reaction force in the pushing in direction by the helical torsion coil spring **53** in a process in which the collected toner box **30** is pushed into the image forming apparatus **10** is f**1**. Further, reaction force in the pushing-in direction by the helical torsion coil spring **53** in a state in which the mounting of the collected toner box **30** in the image forming apparatus **10** is finished is f**2**.

When the urging force of the helical torsion coil spring **53** is fc, the reaction force f**1** is obtained from the following formula, and is adjustable by the inclination angle θ**1** of the helical rib **52***b*.

$$f1 = fc \times \sin\theta 1 \times \cos\theta 1$$

The reaction force f**2** is obtained from the following formula, and is adjustable by the inclination angle θ**2** of the flat plane rib **52***c*.

$$f2 = fc \times \sin\theta 2 \times \cos\theta 2$$

The sealing shutter **52** and the blind shutter **54** do not generate the reaction force in a separation direction in the first state by setting of the inclination angles as described above. For that reason, even with respect to a blank collected toner box **30**, it is possible to maintain a connected state with a collected toner discharging portion **18***a* and the feeding pipe **51** without being constrained to be fixed to a casing of the image forming apparatus **10** by a lever or the like. Then, in a separating process, large reaction force is generated, so that the shutters assist the dismounting of the collected toner box **30**.

(Overturning of Collected Toner Box)

As shown in FIG. **3**, the image forming apparatus **10** employs a constitution in which the collected toner box **30** is disposed at a lower front surface portion and the collected toner is caused to flow through the plurality of delivery portions **50**. From a constraint to a floor area of the image forming apparatus **10**, a shape of the collected toner box **30** is thin with respect to a rearward direction.

The collected toner box **30** with respect to the rearward direction has a high center of gravity, and therefore in the case where the collected toner box **30** is tilted in a front-rear direction, the collected toner box **30** is liable to overturn. The overturning of the collected toner box **30** causes the toner scattering, and is undesirable when placing it on the floor or a desk during exchange of the collected toner box **30** is taken into account.

Therefore, it was studied that the collected toner box **30** is provided with a stationary overturning-preventing member and thus is made less likely to overturn. However, the stationary overturning-preventing member is required to form a recess for receiving the overturning-preventing member in the image forming apparatus **10** side. Further, there is a need to ensure a space for receiving the overturning-preventing member between a front panel of the image forming apparatus **10** and the collected toner box **30**.

In the following embodiments, the collected toner box **30** is provided with the overturning-preventing member of a development type and thus solves this problem. In the mounted state of the collected toner box **30** in the image forming apparatus **10**, the overturning-preventing member is accommodated in a vertically projected plane of the collected toner box **30**, and in the state in which the collected toner box **30** is dismounted from the image forming apparatus **10**, the collected toner box **30** is developed toward the outside of the vertically projected plane, so that a supporting length with respect to the rearward direction is increased.

<Embodiment 1>

(Overturning Preventing Member)

In FIG. **7**, (a) to (d) are illustrations of the overturning-preventing member. In FIG. **7**, (a) shows a developed state of

the overturning-preventing member as seen from a bottom (surface) side, (b) shows the developer state of the overturning-preventing member as seen from a side-surface side, (c) shows an accommodated state of the overturning-preventing member as seen from the bottom side, and (d) shows the accommodated state of the overturning-preventing member as seen from the side-surface side.

As shown in (b) of FIG. **1**, the collected toner box **30** which is an example of a collecting container is provided detachably mountable to the main assembly of the image forming apparatus **10**, and collects the toner fed from the main assembly. The sealing shutters **52** and the shutter **38** which are examples of the shutter open and close the connecting portions between the main assembly and the collected toner box **30**. The delivery portion **50***a* causes the collected toner in the image forming portion to flow into the collected toner box **30** via the rotary-type shutter. The belt cleaning device connecting portion **18***s* causes the collected toner in the belt cleaning device **18** to flow into the collected toner box **30** via the slide-type shutter.

As shown in FIG. **2**, the accommodating portion **32** which is an example of a container portion is connected to the main assembly by the plurality of delivery portions **50***a* and the belt cleaning device connecting portion **18***s* larger in total reaction force in a dismounting direction than the delivery portions **50***a* when the accommodating portion **32** is connected to the main assembly. The accommodating portion **32** is provided with a collected toner box lower surface **32***a* which is an example of the accommodating portion.

As shown in FIG. **4**, the helical torsion coil spring **53** and the shutter spring **38***b* which are examples of a first urging member urge these shutters in a closing direction. As shown in FIG. **7**, a helical torsion coil spring **43** which is an example of a second urging member urges the overturning-preventing member **42** in a direction of rotating and projecting the overturning-preventing member **42**. The delivery portions **50***a* which are examples of a first connecting portion are arranged and disposed in the horizontal direction, and are provided with the sealing shutters **52** (first shutter), respectively. The belt cleaning device connecting portion **18***s* which is an example of a second connecting portion is provided locally in one side of the collected toner box **30** with respect to the horizontal direction. The belt cleaning device connecting portion **18***s* is provided with the shutter **38** (second shutter) larger in reaction force against the collected toner box **30** in the connected state than the sealing shutters **52**.

As shown in FIG. **7**, the overturning-preventing member **42** is provided rotatably relative to the collected toner box **30** and projects outwardly from a side portion of the collected toner box **30** in the main assembly side with the mounting and dismounting operation of the collected toner box **30**, thus preventing the overturning of the collected toner box **30**. The overturning-preventing member **42** contacts the main assembly in a process in which the collected toner box **30** is connected to the main assembly of the image forming apparatus **10** and is accommodated in the lower surface **32***a* of the collected toner box **30**, and when the collected toner box **30** is separated from the main assembly, the overturning-preventing member **42** projects outwardly from the side portion of the collected toner box **30** in the main assembly side, thus preventing the overturning of the accommodating portion **32**. As shown in FIG. **2**, the overturning-preventing member **42** is provided locally in one side of the collected toner box **30** in the horizontal direction, and is disposed in a side opposite from a side, with respect to the horizontal direction, where the belt cleaning device connecting portion **18***s* of the accommodating portion **32** is disposed. During the mounting of the collected toner box **30** in the main assembly, the sum of rotation moment acting on the collected toner box **30** by the helical torsion coil spring **53** and the sealing shutter **38**a and rotation moment acting on the collected toner box **30** by the helical torsion coil spring **43** are directed in directions opposite to each other.

As shown in (b) of FIG. **3**, the casing of the image forming apparatus **10** is provided with a guiding portion **10***a* for guiding the collected toner box **30** in the horizontal direction to permit dismounting of the collected toner box **30** from a predetermined position. As shown in (c) of FIG. **7**, the casing of the image forming apparatus **10** is provided with a contact portion **21***a* which contacts and rotates the overturning-preventing member **42**.

As shown in (c) of FIG. **2**, when the collected toner box **30** is dismounted from the image forming apparatus **10** and is placed in the second state, the overturning-preventing member **42** rotates in an arrow C direction from a state in which the overturning-preventing member **42** is hidden in the projected plane of the collected toner box **30**, and projects from the projected plane of the collected toner box **30**. The overturning-preventing member **42** is held in a state in which the overturning-preventing member **42** projects from the bottom of the collected toner box **30**, whereby a depth of the collected toner box **30** in the second state is increased, and thus the collected toner box **30** is not readily overturned.

As shown in (a) of FIG. **7**, the overturning-preventing member **42** is urged in the arrow C direction by the helical torsion coil spring **43**. The overturning-preventing member **42** is rotated until the rib **30***a* provided at the bottom of the collected toner box **30** and a rib **42***a* provided on the overturning-preventing member **42** contact each other. The ribs **30***a* and **42***a* contact each other, so that rotation of the overturning-preventing member **42** is stopped in a state in which the overturning-preventing member **42** projects from the bottom of the collected toner box **30**.

As shown in (b) of FIG. **7**, in a process in which the collected toner box **30** is pushed into the image forming apparatus **10**, a free end portion **42***b* of the overturning-preventing member **42** contacts a contact portion **21***a* of an interior cover **21** of the image forming apparatus **10**, so that the overturning-preventing member **42** is rotated in an arrow D direction. When the collected toner box **30** is completely mounted in the image forming apparatus **10** and thus is placed in the first state, the overturning-preventing member **42** is accommodated in the projected surface of the collected toner box **30**.

An angle β formed between the overturning-preventing member **42** in the second state and the overturning-preventing member **42** in the first state is 90° or less. For this reason, the overturning-preventing member **42** is smoothly rotated in the process in which the collected toner box **30** is pushed into the image forming apparatus **10**. Further, in a process in which the collected toner box **30** is rotated from the second state to the first state, the overturning-preventing member **42** and the collected toner box **30** are not placed in a perpendicular state. For this reason, in the process in which the collected toner box **30** is pushed into the image forming apparatus **10**, there is no phenomenon such that the overturning-preventing member **42** thrusts and prevents the pushing-in of the collected toner box **30**. These conditions are satisfied, in Embodiment 1, as a load for rotating the overturning-preventing member **42** is kept at a low level, so that a pushing-in operation of the collected toner box **30** can be completed at a relatively small force.

(Rotation Moment Acting on Collected Toner Box)

In FIG. **8**, (a) and (b) are illustrations of a rotation moment suppressing effect by the overturning-preventing member. In FIG. **8**, (a) shows Comparison Example, and (b) shows Embodiment 1.

As shown in (b) of FIG. **1** with reference to FIG. **3**, in Comparison Example, the collected toner box **30** is mounted at a predetermined position of the image forming apparatus **10** in a detachable mountable manner. The delivery portions **50***a*, **50***b*, **50***c*and **50***d* of the image forming apparatus **10** are provided with the above-described shutters **52**. At the connecting portion between the intermediary transfer belt cleaning device **18** and the collected toner box **30**, the slide-type shutter **38** described above is provided.

As shown in (a) of FIG. **8**, the four shutters **52** provided on the delivery portions **50***a*, **50***b*, **50***c* and **50***d* exert reaction forces Fa, Fb, Fc and Fd on the collected toner box **30** in the process in which the collected toner box **30** is pushed into the image forming apparatus **10**. Further, the shutter **38** provided at the connecting portion between the belt cleaning device **18** and the collected toner box **30** exerts a reaction force Fe on the collected toner box **30**.

In general, a collected toner amount of the intermediary transfer belt cleaning device **18** in which collected toners for a plurality of colors are merged and discharged is larger than a collected toner amount of the drum cleaning devices **15***a*, **15***b*, **15***c* and **15***d* for plurality of colors. The reaction force Fe of the slide-type shutter **38** formed in a large size reflecting the collected toner amount is larger than the reaction forces Fa, Fb, Fc and Fd of the sealing shutters **52**.

$$Fa=Fb=Fc=Fd\leq Fe$$

In Comparison Example, by the springs **53** and **38***a* provided on the sealing shutters **52** and the shutter **38**, the reaction forces Fa, Fb, Fc, Fd and Fe in a dismounting direction of the collected toner box **30** from the image forming apparatus **10** act on the collected toner box **30** during the pushing-in of the collected toner box **30**. During the mounting of the collected toner box **30**, there is a need to position the receiving ports **37***a*, **37***b*, **37***c* and **37***d*relative to the delivery portions **50***a*, **50***b*, **50***c* and **50***d* while avoiding the dismounting of the collected toner box **30** by the reaction forces Fa, Fb, Fc, Fd and Fe. During the pushing-in of the collected toner box **30**, there is a need to vertically insert the collected toner box **30** into the delivery portions **50***a*, **50***b*, **50***c* and **50***d* while maintaining an attitude of the collected toner box **30** against the reaction forces Fa, Fb, Fc, Fd and Fe.

Further, the reaction forces Fa, Fb, Fc, Fd and Fe generate rotation moment Ma, Mb, Mc, Md and Me with respect to the collected toner box **30**. As described above, $Fa=Fb=Fc=Fd\leq Fe$ holds, and therefore with respect to the collected toner box **30**, the rotation moment in the counterclockwise direction is generated as a whole as seen from above the collected toner box **30**. When the rotation moment is generated with respect to the collected toner box **30** during the pushing-in, a balance between forces required for the pushing-in of the collected toner box **30** in the left and right directions is destroyed, and therefore operativity is lowered compared with the case where the rotation moment is not generated. A probability that the collected toner box **30** is obliquely pushed in at left and right portions to cause generation of operation errors also becomes high.

Therefore, commonality of the four sealing shutters **52** and the shutter **38** was studied. However, the shutter **38** was excessively large for replacing the sealing shutters **52** therewith. Further, if the sealing shutters **52** are changed to the shutter **38**, it was anticipated that the reaction forces Fa, Fb, Fc, Fd and Fe are increased and thus the operativity when the collected toner box **30** is pushed into the image forming apparatus **10** is further lowered.

Further, based on a premise that the above-described relationship of: $Fa=Fb=Fc=Fd\leq Fe$ holds, it was studied that the arrangement of the delivery portions **50***a*, **50***b*, **50***c* and **50***d* is changed so as not to generate the rotation moment as a whole. However, the change in arrangement of the delivery portions **50***a*, **50***b*, **50***c* and **50***d* increases constraints to design of the image forming apparatus **10** and the collected toner box **30**, and adversely affects downsizing of the image forming apparatus **10** and volume of the collected toner box **30**.

On the other hand, as shown in (b) of FIG. **8**, in Embodiment 1, by adjusting the arrangement of the overturning-preventing member **42**, the rotation moment is prevented as a whole from generating with respect to the collected toner box **30**. By providing the overturning-preventing member **42**, the operativity when the collected toner box **30** is mounted in the image forming apparatus **10** is improved.

A reaction force generated by bringing the overturning-preventing member **42** into contact with the disposition surface of the collected toner box **30** of the image forming apparatus is Ff. An effect of stabilizing the center of gravity of the collected toner box **30** by the overturning-preventing member **42** can be obtained even when the overturning-preventing member **42** is disposed at any position with respect to the left-right direction of the collected toner box **30**. For this reason, the reaction forces Fa, Fb, Fc, Fd and Fe acting on the receiving ports **37***a*, **37***b*, **37***c* and **37***d* at the upper portion of the collected toner box **30** are canceled by the reaction force Ff resulting from a frictional force between the overturning-preventing member **42** disposed at the lower portion of the collected toner box **30** and the disposition surface of the collected toner box **30**.

The rotation moment with which the frictional force between the overturning-preventing member **42** and the disposition surface of the collected toner box **30** acts on the collected toner box **30** is Mf. The rotation moment Mf acting on the collected toner box **30** by the overturning-preventing member **42** varies depending on the disposition of the overturning-preventing member **42** such that the overturning-preventing member **42** is disposed at which position with respect to the left-right direction of the collected toner box **30**.

As shown in (c) of FIG. **2**, in Embodiment 1, by disposing the overturning-preventing member **42** at a right-side position of the collected toner box **30**, the rotation moment Me exerted on the collected toner box **30** by the left-side shutter **38** of the collected toner box **30** is roughly canceled. The overturning-preventing member **42** is disposed in the right side of a left-right center line of the collected toner box **30** correspondingly to the disposition such that a connecting port with the cleaning device **18** where the maximum rotation moment Me is generated is disposed in the left side of the collected toner box **30**.

As a result, the rotation moment Mf generated by the overturning-preventing member **42** cancels counterclockwise rotation moment exerted on the collected toner box **30** by the four sealing shutters **52** and the shutter **38** as a whole. The rotation moment acting on the collected toner box **30** is canceled, whereby an operativity improving effect during the mounting of the collected toner box **30** is obtained. In addition to the overturning-preventing effect which is a natural purpose, an operativity-improving effect during the mounting and dismounting is obtained.

(Effect of Embodiment 1)

As shown in (c) of FIG. **2**, the connecting position of the shutter **38** with the collected toner box **30** is disposed by

shifting the shutter **38** in one of widthwise directions perpendicular to a separating direction and a height direction of the collected toner box **30**. The overturning-preventing member **42** is disposed by being shifted in another widthwise direction of the collected toner box **30**.

For this reason, left and right tensile forces with respect to the widthwise directions when the collected toner box **30** is pulled out become substantially the same, so that the collected toner box **30** is easily pulled out in a straight line. The generation of unnecessary load and friction on the feeding pipe **51** and the like due to obliquely pulling-out of the collected toner box **30** is prevented.

As shown in (c) of FIG. **7**, the overturning-preventing member **42** is disposed rotatably along a disposition table at the lower surface of the collected toner box **30**. The helical torsion coil spring **43** causes a torque to act in a direction of rotating the shutter **38**, with respect to the widthwise direction of the collected toner box **30**, toward the collected toner discharging portion **18***a* of the belt cleaning device **18** shown in (b) of FIG. **1**.

For this reason, the reaction force of the shutter **38** is canceled by the torque, so that even the blank collected toner box **30** can maintain the connection while withstanding the reaction force.

In Embodiment 1, the overturning-preventing member **42** developed and accommodated in interrelation with the mounting and dismounting of the collected toner box **30** relative to the image forming apparatus **10** is provided on the collected toner box **30**, and therefore it was possible to render the collected toner box **30** less likely to overturn without making the change with respect to the image forming apparatus **10**.

In Embodiment **1**, the overturning-preventing member **42** is disposed so as to cancel "the rotation moment generated with respect to the collected toner box by the urging force for closing the plurality of shutters", and therefore compared with Comparison Example, the operativity of the mounting and dismounting of the collected toner box **30** was able to be improved.

In Embodiment 1, the overturning-preventing member **42** is provided horizontally rotatable relative to the bottom of the collected toner box **30**, and therefore at any position during the development, the overturning-preventing effect can be achieved by increasing the length with respect to the depth direction.

In Embodiment 1, the overturning-preventing member **42** is opened and closed by abutting against a wall surface in the image forming apparatus **10** in interrelation with an operation for moving the overturning-preventing member **42** along the disposition surface of the collected toner box **30**, and therefore at any position during the development, it is possible to ensure the length with respect to the depth direction to the maximum.

In Embodiment 1, the overturning-preventing member **42** is disposed at a position where the rotation moment with which the plurality of shutters act on the collected toner box **30** is canceled, and therefore the mounting and dismounting property of the collected toner box **30** was improved.

Incidentally, in the case where the shutter urged by the spring is provided also at the receiving port of the collected toner box **30**, in consideration of also the rotation moment by the spring urging force of the shutter at the receiving port, it is desirable that the overturning-preventing member **42** is disposed so as to cancel the rotation moment as a whole. As a result, the mounting and dismounting property of the collected toner box **30** can be further improved.

<Embodiment 2>

In FIG. **9**, (a) and (b) are illustrations of an overturning-preventing member in Embodiment 2. In FIG. **9**, (a) shows a state in which the overturning-preventing member is developed from a collected toner box, and (b) shows a state in which the overturning-preventing member is accommodated in the collected toner box.

In Embodiment 1, the overturning-preventing member rotationally moves in the flat plane of the bottom of the collected toner box. On the other hand, in Embodiment 2, the overturning-preventing member reciprocates on the bottom of the collected toner box in the horizontal direction. Other constitutions are common to Embodiments 1 and 2, and therefore in FIG. **9**, the constitutions common to Embodiments 1 and 2 are represented by reference numerals or symbols common to FIGS. **1** to **7** and will be omitted from redundant description.

As shown in (a) of FIG. **9**, in Embodiment 2, at the bottom of the collected toner box **30**, an overturning-preventing member **44** operating in parallel to the insertion and extraction direction of the collected toner box **10** relative to the image forming apparatus **10** is provided. The overturning-preventing member **44** is always urged in an arrow E direction parallel to the insertion and extraction direction by a compression spring **45**.

When the collected toner box **30** is in the second state in which the collected toner box **30** is dismounted from the image forming apparatus **10**, the overturning-preventing member **44** moves in the arrow E direction from a state in which the overturning-preventing member **44** is hidden in the projected plane of the collected toner box **30**, and projects from the projected plane of the collected toner box **30**. The overturning-preventing member **44** moves until an abutting surface **44***a* provided on the overturning-preventing member **44** contacts a stopper **30***b* provided on a side surface of the collected toner box **30** and then stops.

The overturning-preventing member **44** is held in a state in which the overturning-preventing member **44** projects from the bottom of the collected toner box **30**, whereby a depth of the collected toner box **30** in the second state is increased, and thus an overturning-preventing effect in a self-supporting state is achieved.

As shown in (b) of FIG. **9**, when the collected toner box **30** is mounted into the image forming apparatus **10**, a free end portion **44***b* of the overturning-preventing member **44** contacts an interior cover **21** of the image forming apparatus **10**, so that the overturning-preventing member **44** is pushed in an arrow F direction against the compression spring **45**. Thereafter, when the collected toner box **30** is mounted in the image forming apparatus **10** and thus is placed in the first state, the overturning-preventing member **44** falls within the projected surface of the collected toner box **30**. The overturning-preventing member **44** provided on the collected toner box **30** is provided so as to capable of being translated from the rear surface of the collected toner box **30** in the insertion and extraction direction, and abuts against the wall surface in the image forming apparatus **10**, and is developed and accommodated in interrelation with the inserting and extracting operation.

Similarly as in the rotary-type overturning-preventing member **42** in Embodiment 1, an effect of stabilizing the center of gravity of the collected toner box **30** by the overturning-preventing member **44** can be obtained even when the overturning-preventing member **42** is disposed at any position with respect to the left-right direction of the collected toner box **30**. On the other hand, the rotation moment Mf acting on the collected toner box **30** by the overturning-

preventing member **44** varies depending on the disposition of the overturning-preventing member **44** such that the overturning-preventing member **44** is disposed at which position with respect to the left-right direction of the collected toner box **30** is most effective.

Therefore, a mounting position of the overturning-preventing member **44** is adjusted so as to cancel rotation moment exerted on the collected toner box **30** by the four sealing shutters **52** and the shutter **38** as a whole. In addition to the overturning-preventing effect, an operativity-improving effect during the insertion and extraction is obtained by disposing a direct-acting overturning-preventing member **44** at the right-side position of the collected toner box **30**.

<Embodiment 3>

In FIG. **10**, (a) and (b) are illustrations of an overturning-preventing member in Embodiment 2. In FIG. **10**, (a) shows a state in which the overturning-preventing member is projected from a collected toner box, and (b) shows a state in which the overturning-preventing member is accommodated in the collected toner box.

In Embodiment 1, the overturning-preventing member rotationally moves in the flat plane of the bottom of the collected toner box. On the other hand, in Embodiment 3, the overturning-preventing member rotates vertically relative to the bottom of the collected toner box in the horizontal direction. Other constitutions are common to Embodiments 1 and 3, and therefore in FIG. **10**, the constitutions common to Embodiments 1 and 3 are represented by reference numerals or symbols common to FIGS. **1** to **7** and will be omitted from redundant description.

As shown in (a) of FIG. **10**, the overturning-preventing member **44** is always urged in an arrow G direction parallel to the insertion and extraction direction by a helical torsion coil spring **47**. When the collected toner box **30** is in the second state in which the collected toner box **30** is dismounted from the image forming apparatus **10**, the overturning-preventing member **46** moves in the arrow G direction from a state in which the overturning-preventing member **46** is hidden in the projected plane of the collected toner box **30**, and is in a state in which the overturning-preventing member **46** projects from the projected plane of the collected toner box **30**. The overturning-preventing member **46** rotates until an abutting surface **46***a* provided on the overturning-preventing member **46** contacts a stopper **30***c* provided on a rear surface of the collected toner box **30** and then stops. The overturning-preventing member **46** is held in a state in which the overturning-preventing member **46** projects from the bottom of the collected toner box **30**, whereby a depth of the collected toner box **30** is increased, and thus an overturning-preventing effect in a self-supporting attitude in the second state is achieved.

As shown in (b) of FIG. **10**, when the collected toner box **30** is inserted into the image forming apparatus **10**, a free end portion **46***b* of the overturning-preventing member **46** contacts an interior cover **21** of the image forming apparatus **10**, so that the overturning-preventing member **46** is rotated in an arrow H direction. Thereafter, when the collected toner box **30** is in the first state in which the collected toner box **30** is mounted in the image forming apparatus **10**, the overturning-preventing member **46** falls within the projected surface of the collected toner box **30**. The overturning-preventing member **46** is provided rotatably relative to the rear surface of the collected toner box **30** in the insertion and extraction direction, and abuts against the wall surface in the image forming apparatus **10**, and is developed and accommodated in interrelation with the inserting and extracting operation of the collected toner box **30**.

Similarly as in the rotary-type overturning-preventing member **42** in Embodiment 1, an effect of stabilizing the center of gravity of the collected toner box **30** by the overturning-preventing member **46** can be obtained even when the overturning-preventing member **42** is disposed at any position with respect to the left-right direction of the collected toner box **30**. On the other hand, the rotation moment Mf acting on the collected toner box **30** by the overturning-preventing member **46** varies depending on the disposition of the overturning-preventing member **46** such that the overturning-preventing member **46** is disposed at which position with respect to the left-right direction of the collected toner box **30** is most effective.

Therefore, a mounting position of the overturning-preventing member **44** is adjusted so as to cancel rotation moment exerted on the collected toner box **30** by the four sealing shutters **52** and the shutter **38** as a whole. In addition to the overturning-preventing effect, an operativity-improving effect during the insertion and extraction is obtained by disposing the rotary-type overturning-preventing member **46** at the right-side position of the collected toner box **30**.

<Other Embodiments>

The present invention can be carried out also in other embodiments in which a part or all of constitutions in the above-described embodiments are replaced with alternative constitutions so long as the overturning-preventing member capable of being developed from and accommodated in the collected toner box is provided.

In this embodiment, the tandem-type color image forming apparatus is described, but the present invention is applicable to also other various image forming apparatuses. If the image forming apparatus is the image forming apparatus in which the collected toner generates, the present invention can be carried out irrespective of one-component developer/two-component developer, the number of the image forming portions, the presence or absence of the intermediary transfer member, the presence or absence of the recording material, the presence or absence of the recording material feeding member, the charging type, the electrostatic image forming type, the transfer type and the fixing type.

With respect to dimensions, materials, shapes and relative arrangement of the constituent elements described in Embodiments 1 to 3, the scope of the present invention is not intended to be limited thereto. In the above-described embodiments, only a principal portion relating to toner image formation and transfer is described, but the present invention can be carried out in various uses such as printers, various printing machines, copying machines, facsimile machines, and multi-function machines, by adding necessary equipment, devices and casing structures.

In the image forming apparatus of the present invention, in the connecting state of the collecting container, the rotation moment direction in the opposite direction to the sum of the rotation moment exerted on the collecting container by the plurality of shutters is caused to act on the collecting container by the overturning-preventing member. Accordingly, it is possible to alleviate the unnecessary rotation moment acting on the collecting container.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purpose of the improvements or the scope of the following claims.

This application claims priority from Japanese Patent Application No. 195150/2013 filed Sep. 20, 2013, which is hereby incorporated by reference.

What is claimed is:

1. An image forming apparatus comprising:

a collecting container, provided detachably mountable to a main assembly of said image forming apparatus, for collecting toner fed from the main assembly;

a plurality of connecting portions, provided at one side surface of said collecting container, for connecting the main assembly and said collecting container;

a plurality of shutters for opening and closing said plurality of connecting portions, respectively;

a plurality of first urging members for urging said plurality of shutters, respectively, in a closing direction;

a movable member provided movably at a bottom of said collecting container, wherein said movable member is moved toward said collecting container by contact with the main assembly when said collecting container is mounted in a mounting portion of the main assembly, and is projected outwardly from a side portion of said collecting container when said collecting container is dismounted from the mounting portion; and

a second urging member for urging said movable member in a direction projecting from said collecting container,

wherein when said collecting container is mounted in the main assembly, said plurality of first urging members and said second urging member are provided so that a sum of rotation moment acting on said collecting container by said plurality of first urging members and rotation moment acting on said collecting container by said second urging member are directed opposite to each other.

2. An image forming apparatus according to claim 1, further comprising:

a plurality of image bearing members for bearing toner images; and

an intermediary transfer member onto which the toner images formed on said plurality of image bearing members are to be transferred,

wherein said plurality of connecting portions include a plurality of first connecting portions for delivering the toner collected from said plurality of image bearing members and a second connecting portion for delivering the toner collected from said intermediary transfer member, and the plurality of first urging members includes first connection portions urging members for urging the shutters for opening and closing said plurality of first connecting portions, and a second connecting portion urging member for urging the shutter for opening and closing said second connecting portion, and

wherein a reaction force exerted on said collecting container by each of said first connecting portion urging members is smaller than a reaction force exerted on said collecting container by said second connecting portion urging member.

3. An image forming apparatus according to claim 1, wherein said movable member is provided to be rotatable relative to said collecting container.

4. A collecting container provided detachably mountable to a main assembly of an image forming apparatus, comprising:

an accommodating portion for accommodating toner;

a plurality of inflowing portions, provided at one side surface of said collecting container, for permitting inflow of the toner;

a plurality of shutters for opening and closing said plurality of inflowing portions, respectively;

a plurality of first urging members for urging said plurality of shutters, respectively, in a closing direction;

a movable member provided movably at a bottom of said accommodating portion, wherein said movable member is moved toward a side portion of said collecting container by contact with the main assembly when said collecting container is mounted in a mounting portion of the main assembly, and is projected outwardly from the side portion of said collecting container when said collecting container is dismounted from the mounting portion; and

a second urging member for urging said movable member in a direction projecting from the side portion of said collecting container,

wherein when said collecting container is mounted in the main assembly, said plurality of first urging members and said second urging member are provided so that a sum of rotation moment acting on said collecting container by said plurality of first urging members and rotation moment acting on said collecting container by said second urging member are directed opposite to each other.

5. A collecting container according to claim 4, wherein said plurality of inflowing portions include a plurality of first inflowing portions each for delivering the toner collected from an associated one of a plurality of image bearing members for bearing toner images and a second inflowing portion for delivering the toner collected from an intermediary transfer member onto which the toner images formed on the plurality of image bearing members are to be transferred, and the plurality of first urging members include first inflowing portion urging members for urging the shutters for opening and closing said plurality of first inflowing portions and a second inflowing portion urging member for urging the shutter for opening and closing said second inflowing portion, and

wherein a reaction force exerted on said collecting container by each of said first inflowing portion urging members is smaller than a reaction force exerted on said collecting container by said second inflowing portion urging member.

6. A collecting container according to claim 4, wherein said movable member is provided to be rotatable relative to said collecting container.

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